

Fine-tuned plant response to insect attack

A caterpillar takes a chew of tobacco leaf. Then another. And another. A wasp appears and plants its stinger in the caterpillar, which eventually becomes food for the wasp's offspring.

There's more to this encounter than meets the eye. Prompted by spittle from the caterpillar, the wounded tobacco plant lofts a chemical scent into the air that tells the parasitic wasps where to find a nice, juicy meal. Even after the caterpillar has been removed, the wasps home in on a plant that has just been attacked.

"They don't just fly around at random until they bump into it," says James H. Tumlinson of the Department of Agriculture's research service in Gainesville, Fla.

Tumlinson and his coworkers are studying the chemical volleying that goes on between many plants and insects, whether enemies or allies. They have now found that plants customize the chemical SOS they emit, alerting the particular wasp that specializes in preying on the offending caterpillar. Consuelo M. De Moraes of the University of Georgia in Tifton reported the new findings at this week's meeting in Nashville of the Entomological Society of America.

De Moraes tested the tobacco plant's response to two closely related insects: the tobacco budworm (*Heliothis virescens*), a common pest of the plant, and the corn earworm, also called the cotton bollworm (*Helicoverpa zea*), which normally doesn't touch the stuff. She induced the earworm to chew on tobacco by providing it with nothing else to eat.

When the plants were moved to the field, parasitic wasps appeared at the plants being chewed on by the budworm, the wasps' preferred host. That result was expected, says Tumlinson, "since you don't normally find corn earworm on tobacco."

The researchers then tested the wasps' reaction to the two caterpillars' attacks on cotton. "The wasps could detect the tobacco budworm on cotton, and they would go to it and not to the corn earworm," he continues. "They could tell the difference."

The difference, the researchers demonstrated, came from a change in the blend of volatile chemicals emitted by the plant in response to each insect's chewing. The researchers fitted glass sleeves over the plant to capture its emissions. An air pump pulled the chemicals onto adsorbent filters.

When they separated and analyzed the chemicals, they found subtle differences in the plant's chemical responses, says

A wasp detects a chemical signal emitted from the damaged area of a corn seedling. Left to right: The wasp approaches the seedling, lands on the damaged section, and finally attacks the caterpillar. The chemical signals emitted by the plant appear to be specific to the type of caterpillar causing the damage.



Tumlinson. Instead of giving off compound A when one insect feeds and compound B when another feeds, "they give off different proportions, or ratios, of compounds A and B." The compounds contain five-carbon structures known as terpenes. Corn plants also produced a varying chemical response when fed upon by the two pests, De Moraes reported.

Although the response needs to be examined in other plants, the results are "a very significant advance" in understanding the complex interactions of plants and feeding insects, says entomologist Richard L. Lindroth of the University of Wisconsin-Madison.

Researchers are interested in exploiting the chemical crossfire between plants and insects (SN: 12/22&29/90, p. 410) as a means of protecting crops. Earlier this year, Tumlinson's group reported the structure of the chemical compound in beet armyworm saliva that induces corn to churn out its chemical SOS.

A wild variety of cotton emits "huge bouquets, or plumes, of these signals," says Tumlinson. It may be possible to enhance the production of such signals in domestic crops as well. De Moraes is exploring the use of specific blends to attract larger numbers of parasitic wasps in the field.

—C. Mlot

Teens show sex-linked pull to cigarettes

Over the past few years, U.S. teenagers have reported rising rates of both occasional and regular cigarette smoking. Preliminary results now suggest that different traits predispose young men and young women to take up cigarettes.

During high school, boys who start smoking often have cigarette-smoking friends and, to a modest extent, report symptoms of depression, according to a study directed by Joel D. Killen of Stanford University School of Medicine. Girls who begin to smoke also have friends who use cigarettes, but in many cases these girls ardently pursue social contacts and close relationships, at least in a sample consisting mostly of white, Asian, and Hispanic teens.

"The current importance that smoking-prevention programs place on self-esteem building and social skills training may be off the mark for the girls most at risk for smoking," Killen and his coworkers contend. "Our data suggest that such girls may already be more gregarious and socially adept than are their peers."

Few studies have examined sex differences in temperamental and social influences on teenagers' use of various substances, including cigarettes, the researchers note.

If the new findings are confirmed, they would support an earlier theory that many boys smoke cigarettes in part to cope with social anxieties, whereas girls who thrive on social interaction and belonging to peer groups prove most willing to adopt group-condoned behaviors, such as cigarette use.

Killen and his colleagues studied a total of 1,901 boys and girls entering one of three Northern California high schools. Students were administered annual self-report surveys for either 3 or 4 years. A majority of the students reported smoking sometime during the study.

The researchers did not focus on factors already linked to teenage smoking that lie outside the realm of school-based prevention efforts, such as a parent's cigarette smoking.

Concerns about weight and excess

body fat showed no link to initial cigarette use, Killen and his colleagues note in the December *JOURNAL OF CONSULTING AND CLINICAL PSYCHOLOGY*.

Sex differences such as those noted in the new study coincide with evidence that female smokers, unlike their male counterparts, appear especially sensitive to aspects of smoking that are not related to nicotine ingestion, according to psychologist Kenneth A. Perkins of the University of Pittsburgh. Such influences may include conditioned responses to seeing and smelling tobacco smoke and the social gratification of smoking rituals, Perkins says.

Sex differences are beginning to appear more often in studies of adolescent substance use, remarks psychologist Todd Q. Miller of the University of Texas Medical Branch in Galveston. In the September *ADDICTIVE BEHAVIORS*, Miller and a colleague report that prior physical and sexual attacks exhibit a strong link to initial marijuana use by teenage girls in a national sample; poor grades and close ties to delinquent friends correspond more closely to boys' willingness to try marijuana.

—B. Bower