Resistant Cotton Stymies Pests

As boll weevil eradication progresses across the U.S. Cotton Belt, cotton growers are tapping a potent arsenal of anti-weevil weaponry.

In the cottonfield, growers can set bait tubes that use a pheromone to lure weevils to their doom. They may also soon enlist tiny, parasitic wasps that hunt the weevils' larvae. And on the high-tech front, computer maps are tracking the weevils' every move so growers can better time insecticidal sprays or other control tactics.

Now Agricultural Research Service scientists are mustering the cotton plant's own natural defenses in combating boll weevils.

At Mississippi State, Mississippi, ARS agronomist Jack C. McCarty, Jr., and colleagues have built a stock of cotton germplasm armed with built-in boll weevil defense: flowerbuds that deter female weevils from laying eggs. McCarty labels such germplasm as "resistant" and says one factor may be that their buds produce low quantities of natural sugars.

For in early summer, a female weevil seeks out cotton buds. She lands, then tastes the buds to gauge whether they're rich enough in the sugars, proteins, and other nutrients her larvae will need for growth. She'll lay her eggs inside the buds if they meet her tastes, so to speak.

"The eggs are actually placed among or in the anthers. There, an abundance of nutrients—particularly sugars—provides an excellent food source," McCarty says. "That also protects the eggs from predators."

But the resistant cotton deters such egg-laying—so much so "you get a reduction of about 50 percent," says McCarty, who is in ARS' Cotton Host Plant Resistance Research Unit at Mississippi State. "That's some of the best resistance we've gotten up to this time."

Otherwise, buds with weevil eggs inside them fall to the ground, or abscise. Detached from the plant, the buds can't produce lint, the fluffy white fiber that growers harvest.

A wild cotton relative gives ARS a back-up weapon in the war against boll weevils.

"Most of the feeding damage to the cotton plant is caused by the male weevil, which tunnels into the bud," McCarty says.

"But growers are more concerned about abscission of the bud."

He worked with chemist Paul A. Hedin and Johnie N. Jenkins, director of ARS' Crop Science Research Laboratory at Mississippi State, to breed the dozen or so germplasm lines. They accomplished this by first evaluating wild cotton strains acquired from Mexico and Central America, cotton's place of origin. There, over thousands of years of evolution, these strains apparently survived the weevil by using built-in genetic resistance.

From their evaluations, the researchers selected 69 weevil-resistant strains. They crossed these with commercial cotton cultivars, selecting germplasm lines whose flowering would allow for further testing.

During trial plantings at Mississippi State from 1987 to 1993, "the resistant germplasm lines generally received half as many egg deposits as commercial varieties used as checks," McCarty says.

Cooperating researchers at Texas A&M University at College Station and Louisiana State University's Experiment Station at Baton Rouge reported similar findings in test plantings there.

Maurice J. Lukefahr of Rio Farms also grew the resistant cotton on 1-acre plots in Ed Couch, Texas. Lukefahr, a retired ARS entomologist who worked with the Mississippi researchers in earlier studies, says he sprayed insecticide three or four fewer times on the test plots than on his commercial acreage.

Cotton nears harvest. Photo by David Nance. (K5975-4)

"Typically," notes McCarty of such field tests, "it takes 3 to 4 weeks longer for boll weevils to reach damaging population levels. So you would delay spraying insecticide until that time."

For cotton growers, that delay can mean significant savings in insecticide costs. It can also mean less residual insecticide in the environment—a main objective of scientists in breeding pest-resistant crops.

However, "The resistant germplasm lines aren't at a commercial state, as far as their yield and other agronomic properties are concerned," McCarty says. That's because it's taken more than a decade's worth of backcrossing and field-testing to confirm that the resistance trait remains stable, passing from one plant generation to the next.

It's also taken extensive laboratory testing and chemical analysis for the researchers to "finger" the trait's influence on weevil egg-laying.

"We looked at terpenoids, allelochemicals, surface waxes, and a number of other compounds," Hedin says. "The only thing we were sure had an identifiable effect on egg-laying in laboratory tests was the low sugar. But that's probably not the entire answer as to why we get lower egg numbers."

Now, eradication may quell the need for breeding the germplasm as higher-yielding commercial varieties, Hedin says. In eradication, cotton growers, industry representatives, and state agricultural officials coordinate pesticide use and other tactics to boot weevils from the state, region by region.

In Mississippi, Tennessee, and other cotton-growing states, researchers and grower associations foresee weevil eradication in 8 to 10 years.

"Boll weevil eradication is at least in our sights now," says Andy Jordan, Technical Service director for the National Cotton Council of America in Memphis, Tennessee. "But I think we'd be remiss not to develop alternative weevil control technologies."

JACK DYKINGA

Boll weevil on a cotton bud. (K6009-2)

Jordan envisions that as a commercial crop, weevil-resistant cotton might benefit growers who don't use insecticides because their fields are near residences, wildlife preserves, or other sensitive areas.

Also, the boll weevil has withstood efforts to vanquish it for over 100 years, reigning as cotton's "pest supreme" since it arrived in Brownsville, Texas, from Mexico in the early 1890's. With that in mind, resistant cotton could offer a comforting safeguard or buffer in states bordering areas that still have the pest.—By **Jan Suszkiw**, ARS.

Jack C. McCarty, Paul A. Hedin, and Johnie N. Jenkins are at the USDA-ARS Crop Science Research Laboratory, P.O. Box 5367, Mississippi State, MS 39762; phone (601) 323-2230, fax (601) 323-0915. ◆