Mealybugs May Have Met Their Match

Insect predators and parasites home in on this growing menace.

The pink hibiscus mealybug (PHM) is a native of Southeast Asia. But wherever it goes, it can inflict serious damage to ornamental plants—notably hibiscus—and important crops such as bean, beet, cabbage, citrus, corn, cotton, cucumber, grape, lettuce, peach, pear, pepper, pumpkin, okra, squash, and tomato.

Oval, pink, wingless adult PHM females are just 1-3 mm in length. But when they feed, their saliva leads to malformation of fruit, leaves, and shoots, stunting the plant and eventually killing it. Crop losses in the United States could reach $750 million per year if ways to control the pest are not found. Fortunately, ARS scientists in Fort Pierce, Florida, and Beltsville, Maryland, have made key advances that will help win the battle against PHM.

This species of mealybug, *Maconellicoccus hirsutus,* has spread throughout the Caribbean region since first being detected on the island of Grenada in 1994. It later spread to Mexico, Central America, and in 2002, Florida. USDA's Animal and Plant Health Inspection Service (APHIS) and the Florida Department of Agriculture and Consumer Services responded together to the Florida infestation by releasing two effective parasites *(Anagyrus kamali* and *Gyranusoidea indica)* and a predatory ladybug *(Cryptolaemus montrouzieri)* to control the mealybug, which has resulted in over 98 percent reduction in PHM population density. Despite these efforts, plants from an infested ornamental nursery in Florida were shipped last year to 36 other U.S. states—and PHM may have been hiding in some of these shipments and may become established in these states. APHIS is therefore expanding production of PHM natural enemies in preparation for release in other states.

Scientists in ARS's Subtropical Insects Research Unit, headed by David Hall at the U.S. Horticultural Research Laboratory in Fort Pierce, have been key in PHM research. Their efforts began long before the pest came into Florida. Working in St. Croix, U.S. Virgin Islands, ARS scientist Stephen Lapointe discovered that female PHM emitted a powerful pheromone that attracted males. This ultimately led to creation of a synthetic equivalent, or analog. (See story on page 18.) To assist with the development of this chemical, Lapointe used a hormone analog to eliminate male PHM from a colony, leaving only females for pheromone analyses.

Lapointe also developed a simple diet for rearing the mealybug. While those raised on the diet were not as fit as ones reared on some plants, the research showed that PHM could easily be reared on an artificial diet.

For release of biocontrol insects like *A. kamali* and *C. montrouzieri,* they must be available in sufficient supply. Since it's very time consuming and inefficient to catch them in the wild, scientists rear the biocontrol agents in captivity on their host insect. But successful mass-rearing of insects like PHM requires an environment and a diet conducive to their successful development and reproduction.

Faced with an expanding infestation range and the need to increase production

STEPHEN AUSMUS (D042-16)

This hibiscus plant shows leaf deformation and terminal stunting from mealybug feeding. Research leader David Hall examines mealybugs being preyed upon by ladybugs.

STEPHEN AUSMUS (D044-7)

A healthy pink hibiscus (left) and one with severe damage caused by pink hibiscus mealybugs.

of the mealybug's natural enemies, APHIS requested help from ARS in developing an artificial diet for the bugs. Lapointe's earlier work on this problem would therefore pay off.

Lapointe is developing a new artificial diet that should, in time, eliminate costly greenhouse rearing of PHM. He began by feeding the mealybugs an assortment of crops in test greenhouses and verified that a particular variety of Japanese pumpkin was their favorite.

"We were able to successfully rear generations of PHM, and more importantly, we achieved complete development of parasitoids on mealybugs reared on the artificial diet based on canned pumpkin and sugar," says Lapointe.

The diet requires further refinement to produce quality mealybugs in the large numbers required. The goal is to formulate an inexpensive diet based on readily available materials and supplemented with nutrients required for complete mealybug development and successful production of parasitic wasps.

Developing insect diets is laborious because of the many nutrients that must be tested to determine the quantities required for normal and complete development.

"It would be prohibitively expensive and time consuming to test each diet component individually," says Lapointe. So he and ARS plant physiologist Terence Evens are applying a sophisticated statistical approach to the problem of solving multiple equations simultaneously. The approach, called Response Surface Methodology, has only recently become feasible for such applications because of the tremendous increase in computing power now widely available. Lapointe and Evens hope to show how this method can be applied to development of insect diets in general and to the particular problem of designing an effective diet for PHM.

By raising healthy, well-fed mealybugs, researchers will be best able to produce the quantities of *A. kamali* wasps and *C. montrouzieri* ladybugs needed for successful PHM-control programs.

"Our studies have shown that the quality of the parasitoids and predators we raise is directly related to the quality of the mealybug host they're grown on," says Lapointe. Once the new formulation is perfected, this artificial diet will, ideally, produce a new generation of adult mealybugs every 21 days.

"APHIS came to us with their research needs," says Hall, "and we've responded with some great results so far. We're excited that we're able to work hand-in-hand in this effort to get rid of this invasive and troublesome insect."—By **Alfredo Flores,** ARS.

This research is part of Crop Production, Product Value, and Safety, an ARS National Program (#304) described on the World Wide Web at www.nps.ars.usda.gov.

David Hall and Stephen L. Lapointe are in the USDA-ARS Subtropical Insects Research Unit, 2001 South Rock Rd., Fort Pierce, FL 34956; phone (772) 462-5814, fax (772) 462-5986, e-mail dhall@ushrl.ars.usda.gov, slapointe@ushrl.ars.usda.gov. ✸

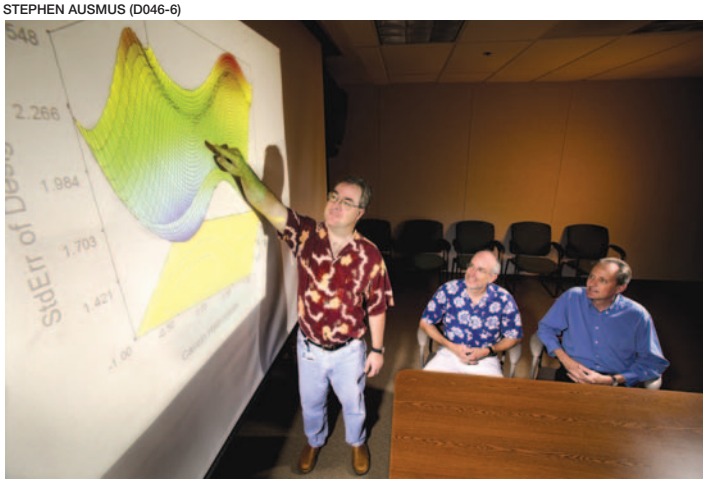
STEPHEN AUSMUS (D043-9)

Technician Carol Wyatt-Evens prepares a diet for rearing pink hibiscus mealybugs. The cost of the diet is kept down by using commonly available materials such as canned pumpkin and vitamin supplements.

STEPHEN AUSMUS (D047-8)

To monitor mealybug population density, technician Kathryn Moulton collects traps containing a pheromone lure and a sticky card. Male pink hibiscus mealybugs are attracted to the synthetic lure and get stuck in the adhesive.

STEPHEN AUSMUS (D046-6)



Ecologist Terence Evens (left) explains to entomologist Stephen Lapointe (middle) and research leader David Hall how Response Surface Methodology can be used to simultaneously solve equations for multiple diet variables. The resulting three-dimensional graph indicates optimal diet mixtures.