CONTROLLING HAWAII'S FRUIT FLIES[1]

Researchers at the ARS Pacific Basin Agricultural Research Center in Hilo, Hawaii, describe a new USDA-ARS areawide IPM project to control this group of troublesome flies

Introduction

In Hawaii's warm, mild climate, exotic tropical fruits and vegetables flourish nearly year-round. Unfortunately, so does a quartet of subtropical fruit fly pests – the Oriental fruit fly, melon fly, Mediterranean fruit fly, and solanaceous (Malaysian) fruit fly.

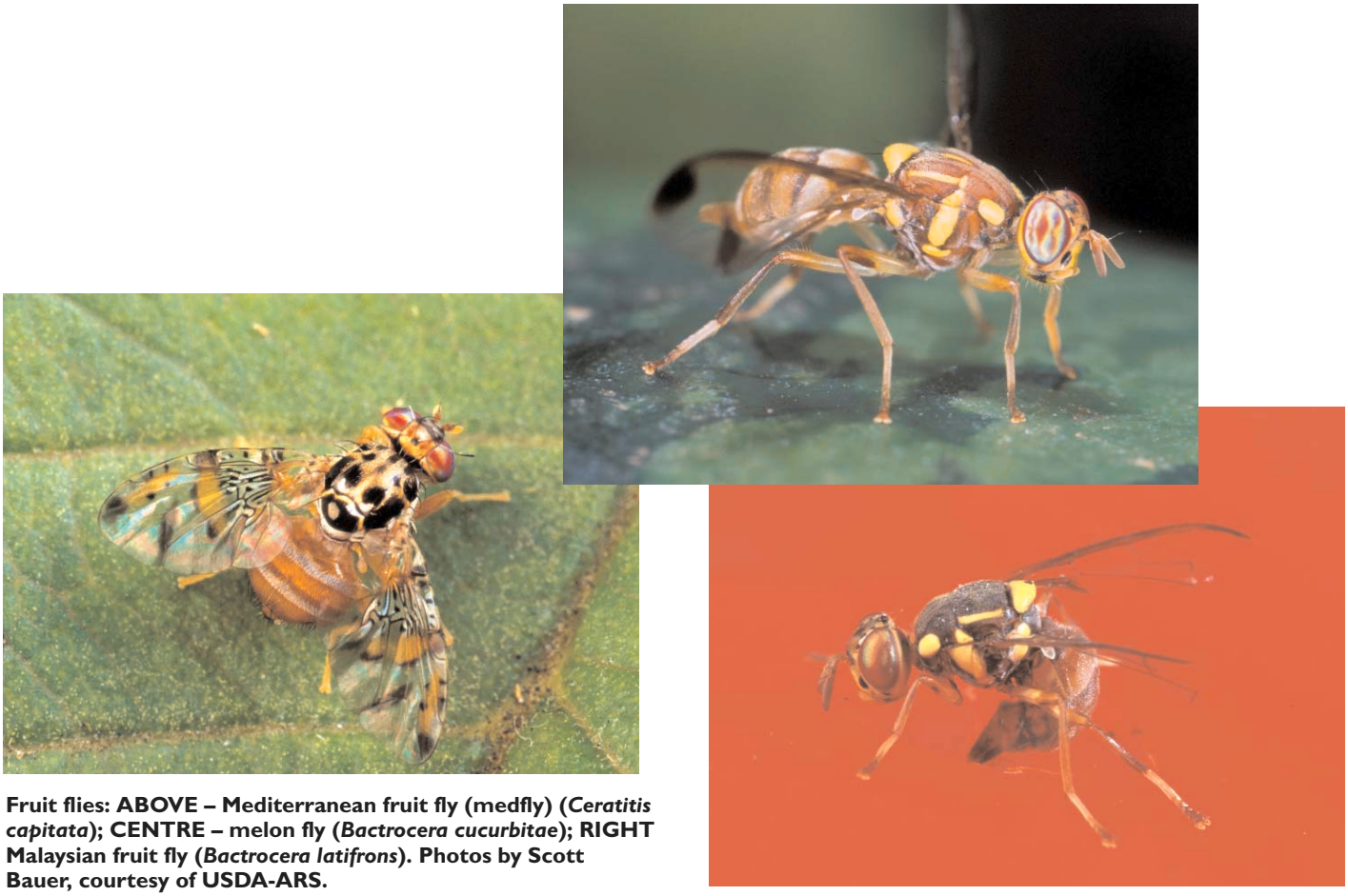
These invasive insects, none native to the Hawaiian Islands, can easily turn what should be a fresh, luscious taste treat into a disgusting mess. That's what happens soon after the female fruit fly punctures the skin of a nicely ripening fruit or vegetable and pumps her eggs into it. The tiny, wriggling maggots that later hatch spoil what would otherwise be a delectable crop.

[1] Adapted from an article in *Agricultural Research*, published by the USDA-ARS (http://www.ars.usda.gov/is/AR/)

ARS researchers are targeting these troublesome flies in one of the agency's newest and most complex areawide integrated pest management (IPM) programs. The goal: to give Hawaii's growers the latest and best science-based, environmentally sound strategies for reducing crop losses and the need for organophosphate and carbamate insecticides.

Gearing up grid by grid

The intent is to help farmers keep the flies under control in carefully delineated suppression grids. These grids might include not only participating growers' fields and orchards, but also nearby vegetation where significant numbers of exotic flies live and breed. Patches of wild guava in pastures that are within a few miles of a melon field or nearby



Fruit flies: ABOVE – Mediterranean fruit fly (medfly) (*Ceratitis capitata*); CENTRE – melon fly (*Bactrocera cucurbitae*); RIGHT Malaysian fruit fly (*Bactrocera latifrons*). Photos by Scott Bauer, courtesy of USDA-ARS.

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Fruit fly larvae in papaya. Photo by Scott Bauer, courtesy of USDA-ARS.

backyard plantings of pumpkin or zucchini, for example, might need to be included within a grid. If not, the insects could use the patch or garden as a safe haven and as the base for their attack on the neighboring fields. The program involves a combination of tactics that will be practical, affordable, and workable, not just one method for going after flies in these suppression grids. The grid approach is very different from attempting to obliterate the fruit flies everywhere they live in the Hawaiian Islands chain. Four key pests, are being targeted, not just one, while there are dozens of crops at risk from these flies: papaya, mango, melon, squash, cucumber, tomato, pepper, and eggplant, not just a single commodity like corn.

Control tactics

Interest in the program is growing among farmers in the Aloha State, including some who were initially reluctant to join the project. Today, plans call for using at least four different control tactics – sanitation, male annihilation, bait sprays, and biological controls – at demonstration sites on the islands of Hawaii, Maui, and Oahu.

The program is a joint venture of ARS, the University of Hawaii, and the State of Hawaii Department of Agriculture. Scientists and specialists from these institutions are dividing up the work of developing and demonstrating technologies for suppressing the voracious fruit flies. Other partners include grower organizations and agricultural businesses.

Sanitation

Thorough and unrelenting sanitation that removes as much infested fruit as possible is basic for every orchard and field. The researchers have developed methods for disposing of these culls ranging from something as simple as a well-sealed plastic bag to a tent-like structure that sequesters the flies, but lets the fruit flies' natural enemies return to the crop. Another tactic some local growers use – drowning ruined fruit – is being scrutinized.

Fruit fly larvae feasting on surinam cherries. Photo by Peggy Greb, courtesy of USDA-ARS.

AREAWIDE IPM AT USDA-ARS

In 1994, the Agricultural Research Service launched an ongoing series of areawide integrated pest management (IPM) projects. Each project was proposed from the field and reviewed by a technical staff. Although each project has research, education, and assessment components, the focus has been to pull together existing technology and research results into an integrated management plan that could be demonstrated for, and transferred to, users. Each project is funded for up to 5 years and then carried on by cooperators, growers, and land owners.

So far, the projects have met or exceeded their goals. All have shown significant reduction in pesticide use and have garnered wide support, ranging from scientific colleagues to individual farmers. Six areawide IPM projects for fire ants, fruit flies, stored-grain insects, leafy spurge, corn rootworm, and codling moth are in progress, and additional areawide programs were funded in 2001 to tackle lygus bug, Russian wheat and green peach aphids, and melaleuca trees.

Even though the individual projects are time-limited, their success shines through as users continue them without the official infrastructure initially provided by the projects.

For more information on Areawide IPM at the USDA-ARS see Agricultural Research Magazine, November 2001, 49(11), 11–13.

Male annihilation

A procedure aptly named "male annihilation" is a proven success at zapping fruit fly males. That causes populations to collapse. Male annihilation relies on traps that contain an irresistible lure to bring the flies to it and a second compound that kills them once they touch or eat it. ARS scientists at the Hawaii laboratory have played a key role in developing powerful lures that entice Oriental fruit flies, melon flies, or medflies to visit these deadly traps.

Bait sprays

Protein-bait sprays applied from the ground provide another way to blast the flies. Key to these sprays is protein derived from corn, wheat, or other sources, which the flies find too good to resist. When mixed with a compound that kills the flies, such as spinosad, growers have an effective and environmentally safe weapon in their toolkit. In outdoor tests, conducted over the past several years in Hawaii, ARS research entomologists have provided some of the best available information about the effectiveness of spinosad against tropical fruit flies.

***Psyttalia fletcheri* is the only fruit fly parasitoid introduced into Hawaii capable of parasitizing the melon fly (*Bactrocera cucurbitae*). Photo by Scott Bauer, courtesy of USDA-ARS.**

Biological control

A biological control tactic known as the sterile-insect technique offers yet another way to outwit the flies. It requires releasing flies that have been sexually sterilized in the laboratory. When these sterile males mate with wild, fertile females, no fertile offspring result, so the population dies out. Key to this technology is the ability to continuously rear populations of healthy flies that can outcompete wild, fertile males in winning the attention of the females. In past decades, ARS scientists in Hawaii have developed, tested, and fine-tuned all the steps needed to raise laboratory colonies of the invasive fruit flies – a must for the sterile-insect technique.

The researchers have also refined the process of rearing masses of a hard-working biological control agent named *Fopius arisanus*. This tiny wasp is harmless to humans. Female wasps parasitize fruit flies by inserting their eggs into fruit fly eggs. Puncturing the eggs kills some fruit fly young outright. Others die when parasite young develop inside them.

Future outlook

New discoveries by ARS scientists should streamline use of the sterile males and busy wasps. A geneticist based at the center's Honolulu laboratory has bred a line of melon flies that can be mechanically sorted according to their sex while they are pupae – the last stage before they become adults. In the wild, both males and females normally have a brown pupal case, a cocoonlike covering. In the new line, in contrast, only males have this brown casing. The females have a telltale white pupal case. High-speed color-sorting machines are used to segregate the genders.

White-encased females are thrown away, while the males are put aside for the outdoor work. Simple, fast, and reliable, this color-sorting strategy saves some of the time and expense that would otherwise be invested in unneeded females. Though similar breeding work has been done elsewhere to produce color-sorted strains of other fruit flies, this work is a first for the melon fly.

Also in the wings is a new and more efficient way to raise the tiny *F. arisanus* wasp indoors. Entomologists developed a new breeding cage that streamlines the rearing procedure, offers savings in labor, and enables laboratory managers to produce a steady supply of the hard-working wasps for lab and field tests. What's more, the scientists are testing the same cage for possible use as an outdoor delivery system for another beneficial insect, *Psyttalia fletcheri*. This diminutive wasp is a powerful natural enemy of the melon fly. The delivery system could provide researchers and growers with a quicker and easier way to distribute the wasps throughout their fields and orchards. A patent for the invention will be sought.