

## THE CRANBERRY HIGHWAY FROM CORNELL TO CAPE COD

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By L. McCandless

GENEVA, NY: When Cornellians hear the word "cranberries," they think of the moist bogs where cranberries grow, Ocean Spray's "Crave the Wave" advertising campaign, and the traditional Thanksgiving holiday meal of turkey, dressing, and cranberry sauce. What Cornellians rarely consider is the university's connection to cranberry research in Massachusetts.

But, thanks to the work of a team that includes soil insect ecologist Paul Robbins, cranberry growers in Massachusetts are one step closer to managing pests that adversely affect the state's \$200 million cranberry industry.

"There are about 30,000 species of beetles in North America of which 1500 species are scarab beetles," says Robbins, who works at the New York State Agricultural Experiment Station in Geneva, NY. "The larvae of at least five species of these scarabs feed in the root systems of cranberry bogs. These species include the Japanese beetle, (*Popillia japonica*), the Oriental beetle (*Exomala orientalis*), the cranberry white grub (*Phyllophaga anxia*), the cranberry root grub (*Lichnanthe vulpina*), and *Hoplia modesta*, a small beetle species for which there is no common name. The larval feeding weakens the root system of the plant, thereby reducing yield. Equally important, weak roots reduce vine density which predisposes the bog to weed invasion."

This spring the Cornell team completed the identification of the



Soil ecologist Paul Robbins uses a turf axe to search for the grub stage of the cranberry white grub (*Phyllophaga anxia*). CREDIT: R.Way/NYSAES/Cornell

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The adult stage of the cranberry root grub (*Lichnanthe vulpina* [inset 2] is also known as "Foxy Red." The pheromone chemistry for these pests of cranberry were recently identified by Cornell scientists.

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sex attractant of the last of the five scarab species in cranberries, *Hoplia modesta*. The group had previously identified the sex attractants of all but the Japanese beetle, whose pheromone was already known.

### **The Cornell Connection**

The Cornell connection to the cranberry industry began when Anne Averill, a former post-doctoral associate in the Geneva lab of entomologist Wendell Roelofs, left Cornell to accept a position as the cranberry entomologist at the Massachusetts Cranberry Experiment Station in East Wareham near Cape Cod. An agreement between Averill and Michael Villani, a soil ecologist at the Experiment Station in Geneva, led to a cooperative project that involved Robbins traveling to the Cape Cod area to collect beetle larvae for research and to observe behavior of adults.

"Digging the beetle larvae, or grubs as they are called, out of the cranberry bog is strenuous," Robbins relates. "It's not like digging grubs out of turf as our lab often does in the fall in the Geneva area. You have to slice through the thick mat of cranberry vines with a tool called a turf ax and push hard to roll it back. The density of grubs is usually not nearly as great as in turf, so you have to search a greater area to get the same number of larvae."

Observations of the night flying June beetles (*Phyllophaga anxia*) have taken Robbins to the cranberry bogs for nocturnal forays. Using a light overlaid with a red gel (insects will not fly to the red light) attached to a car battery, he has videotaped the males flying to traps baited with the synthetic sex attractant. "As I look at the video today, it resembles what I've seen of the *Blair Witch Project* because the beetles were flying into my hair as I was trying to hold the camera steady," says Robbins.

Another link in the Cornell cranberry connection is Aijun Zhang, yet another former post-doctoral associate from Roelofs' lab. Zhang was involved in the identification and synthesis of all four of the scarab sex pheromones elucidated by the Cornell connected group. Zhang currently works as a chemist for the USDA in Beltsville, Maryland.

Identification of the pheromone of the cranberry white grub, *Phyllophaga anxia*, led Robbins to the subject of his Ph.D. thesis, that of geographical variation in the male response to

### **New York's Growing Cranberry Industry [POSSIBLE SIDEBAR]**

New York has a fledgling cranberry industry. In 1999, the NYS legislature allocated

\$100,000 to support this industry. The money will be used to fund research on production and post-harvest issues. Cornell Cooperative Extension of Oswego County established two research plots in 1996, and some of the research is expected to take place on those experiment plantings. Researchers and staff from Cornell and the Experiment Station are likely participants in this effort to provide research-based knowledge to the New York State cranberry industry.

*L. McCandless*

### **Cranberries Are a Valuable Wetland Crop [POSSIBLE SIDEBAR]**

Cranberries are a native American wetland fruit. They are the number one food crop in Massachusetts, providing more than 5,500 jobs and \$200 million to the Massachusetts economy. The more than 500 cranberry growers in Massachusetts produce more than 38 percent of the nation's supply. In so doing,

the sex attractant of this species. "*Phyllophaga anxia* is perhaps the most common species of the genus *Phyllophaga* throughout its range, although it is a pest only on cranberries in Wisconsin and Massachusetts," Robbins notes.

### **Pheromones and Beetle Genitalia**

The pheromone the team identified consists of a particular blend of two chemicals, the methyl esters of valine and isoleucine, both essential amino acids.

"When we deployed these two chemicals in test blends ranging from 100/0 to 0/100 in over 35 locations throughout the U.S., we found extreme variation in the male response," says Robbins. "Sometimes the males fly to 100 percent valine, in another location to 100 percent isoleucine, in another to a blend of the two, and, in another, the response is split down the middle, with half the males at a given location flying to each chemical."

Robbins is ready to test his hypothesis that it is pheromonal conflict between different species of *Phyllophaga* using the same blends of these chemicals that pushes this disruptive selection.

According to Robbins, there are over 200 species of *Phyllophaga* in the U.S. and they can only be taxonomically separated by the internal male genitalia. Robbins has examined nearly 20,000 beetle genitalic structures in the course of the study to identify the nearly 40 different *Phyllophaga* species trapped using these two compounds. He likes the idea that an economic problem was the starting point for driving a study in basic biology.

Cranberry growers are optimistic that these sex attractants can be used to help manage scarab soil pests in bogs in both Massachusetts and Wisconsin. At-risk bogs can be identified using these compounds as monitoring tools. Preliminary research in Massachusetts indicates that mass trapping of *P. anxia* may be possible to reduce grub populations on bogs to acceptable levels and microencapsulated formulations of these chemicals may be irrigated on to the bogs to disrupt mating activity of the beetles.

The Cape Cod Cranberry Growers Association and Ocean Spray Cranberries, Inc funded the work.

they preserve more than 61,000 acres of open space, of which approximately 13,000 acres are the actual cranberry production beds themselves. This cranberry wetland system is a diverse habitat for many rare animal and plant species.

During harvest, many growers flood their bogs causing cranberries, which have small air pockets in the center, to rise. They then use water-reel harvesting machines to loosen cranberries from the vines causing them to float on top of the water. After floating to the top, berries are corralled by men in waders wielding long rakes onto conveyer belts and into waiting trucks. Eventually the cranberries are processed into juice, sauce and other processed foods.

About 10 percent of the cranberries grown in Massachusetts are dry harvested and sold as fresh fruit. To dry harvest, growers drain the bogs and use lawn mower-shaped mechanical pickers.

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## NOTE TO EDITORS:

Other color cranberry photos are also available by request to Rob Way at [rfw2@cornell.edu](mailto:rfw2@cornell.edu), including:

3 & 4. Because cranberries float, growers flood the bogs in the fall at harvest, raking and corraling the fruit into booms, where they are then conveyed by belts into waiting trucks and shipped for processing.

5. Cranberries for fresh consumption are dry harvested using a mechanical picker, shown here at the Massachusetts Cranberry Experiment Station in Wareham, MA.

6. Close up of a mechanical picker.

7. Dry harvested cranberries, waiting for sale, are sorted, bagged and sold as fresh fruit.

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