The midge that eats more kale

November 13 2014, by Joshua E. Brown

Near where Foot Brook flows in the Lamoille River, Tony Lehouillier (left) started a diversified organic vegetable farm in 1997 after studying plant and soil science at UVM. He become an expert at growing brassica plants, including kale that he sells wholesale to Whole Foods Market. Now he has a new challenge: an invader that chows on kale. UVM entomologist Yolanda Chen has been consulting with Lehouillier and other farmers across Vermont in her quest to stop the deadly march of this midge. Credit: Joshua Brown

Three years ago, Tony Lehouillier began to worry about some of his purple kale. "It was just weird looking," he says, cupping his hands around a tall stalk on his farm near Johnson, Vt. "Then the top would start to die. Plants would fold over." Others had strangely puckered leaves and brown scarring. The blighted kale didn't necessarily die, but it wasn't marketable either. For Lehouillier, one of Vermont's largest

organic growers of kale and other cabbage-family crops—like broccoli—the mysterious damage looked like disaster.

It turned out the culprit was a tiny pest called swede midge. Soon, Lehouillier was in touch with Yolanda Chen, an assistant professor in UVM's Department of Plant and Soil Science—the only researcher in the United States actively studying the midge.

The swede midge is a threat not only to the viability of Lehouillier's farm but to local organic production of these key crops throughout the state—unless Chen and her students find a way to fight the fly.

Bombing brassicas

The crops at risk—brassicas—play a major role in our diet. This large plant family includes kale, broccoli, and turnips, and their relatives—including cauliflower, brussels sprouts, bok choy, collard greens, kohlrabi, canola and Chinese cabbage. All are vulnerable to the swede midge, an invasive fly—but not from Sweden, as its name seems to suggest. "Swede" in this case refers to Swedish turnip, or rutabaga. Long known across Europe and Asia, the midge was first detected in Canada in 2000 and then turned up in New York State in 2004. The first Vermont case was submitted in 2006 to the UVM Plant Diagnostic Clinic by farmer Andy Jones at Burlington's Intervale Community Farm.

"We typically see a six- or seven-year lag before it really starts spreading," Chen says. "I'm concerned about the lack of awareness of this problem,"—since there have been accounts from organic growers in central New York and Canada of 100 percent crop losses in heavily infested areas. Conventional growers are moving toward attacking the midge with systemic insecticides—those taken up by the plant so that the insecticide is found within the plant tissues. "However," Chen says, "the neonicotinoid insecticides that have been used in this way are currently

implicated in honeybee decline."

At UVM's Insect Argoecology Lab, graduate student Gemelle Brion examines a broccoli plant for signs of swede midge.

The midge spends the winter in the top layers of the soil and then emerges in waves from May to October. Eggs are laid on the newest growth of plants during a female's few-day lifetime. Concealed in the growing tips of the crops, the larvae feed happily. "Even the most toxic insecticides have made a comeback among conventional growers in Ontario, a heavily afflicted region," Chen says, "but without much success because the midge is found within the folds of the plant buds." For organic growers, "there are currently no suitable control options," Chen writes. Crop rotation and destroying plants immediately after harvest can help, but once the midge is established, it's virtually impossible to eradicate.

"Basically, what you get is headless broccoli," she says. In recent years, the United States has grown nearly two billion pounds of broccoli, according to the USDA, with fresh broccoli exports valued at $136 million in 2011. The swede midge should be able to live in any area where brassica crops are grown, Chen thinks. "It's just a question of how fast it will spread," she says.

Oils and intercrops

Under grow-lamps at UVM's Jeffords Hall, the swede midge isn't spreading more than a few feet. The light-brown flies zip around inside clear plastic boxes, landing on Nigella and broccoli plants. Even in the bright white light, the insects are so small as to be barely visible. This is Chen's research space, UVM's Insect Agroecology Lab, the only lab in the United States working on swede midge, and one of two labs in North America (including Chen's collaborator Rebecca Hallett, at the University of Guleph, in Canada) working on midge pest control options for organic farmers and gardeners.

Because there are no organic methods for killing the pest, "there is a critical need to identify control strategies for disrupting midge activity," Chen says. Her graduate student, Chase Stratton, has found several plant essential oils, that look promising in reducing the number of midge offspring on test plants. And Chen and Brion have been testing twenty-one different plants that vary in their degree of relatedness to brassicas as so-called "intercrops." These are plants that could be grown in and around farm fields to reduce midge density on the main crop.

"As an insect herbivore that is specialized on the plant family Brassicaceae, swede midge are particularly adept at finding brassica plants using plant odors in the field," Chen explains. The essential oils and intercropped plants take this skill and use it against the midge to confuse them with many attractive odors, masking the main crop.

Before Chen's lab can make specific recommendations for organic growers, the most promising of these plant oils and intercrops will be tested in field trials next spring at the Geneva campus of Cornell University—with Chen's collaborator, Cornell professor Tony Shelton—where several local organic farms have recently experienced complete loss of their brassica crops.

Deep time

"Crops have only been around for 13,000 years at most," Chen says, "but today's insect/plant interactions are very deep. They probably go back 65 million years." Stepping back from the specific problem of invasive swede midge and the simplistic focus on trying to blast pests with toxins, Chen and her students aim to bring ecological and evolutionary information to improve pest management. "Can studying how plants are related help us in designing better agricultural systems?" Chen wonders. "Are there rules—assembly rules—based on plants' geographic origins and relationships that can help us make better intercropping systems?"

"Most, if not all, of the crops that make up the diet of the average American have been brought from elsewhere," Chen says. A perspective informed by deep time is that "invasive species such as the swede midge are simply getting reunited with their host plants," she says. "I want consumers to understand the enormous challenges that organic growers are up against to produce a crop."

For now, Tony Lehouillier's kale and other brassicas are a mixed bundle: some looked splendid all fall and sold well in wholesale markets; others were a "gross mess," he says. He wonders what the spring will bring to his hundred-acre farm and to other organic growers in the state. "We've got the midge now and have to live with it," he says, waving his long arms across neat rows of kale that make a purple V toward the Lamoille River—the boundary of his land. " I don't think it's made it over the

mountains," he says, now waving toward the east, "yet."

Provided by University of Vermont