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Penn State researchers tackling mushroom phorid fly infestations

UNIVERSITY PARK, Pa. -- Working with mushroom growers and residents in southern Chester County, Penn State's College of Agricultural Sciences is ramping up ongoing research efforts to alleviate mushroom phorid fly infestations in southeastern Pennsylvania.

Swarms of the tiny flies associated with mushroom production in two Chester County townships have besieged residents in rural developments in recent years, especially in late summer and fall. The phorid fly infestations also damage mushrooms, limit crop yields and make the job of picking mushrooms onerous.

"We have a really strong team of researchers working on this and they are exploring every sensible, reasonable avenue for controlling phorid flies," said Rick Roush, dean of the college. "Unfortunately, it's a very difficult problem, but we are committed to finding a way to provide some relief for the residents."

Roush, who was director of the integrated pest management program for the state of California from 2003 to 2007, is optimistic that Penn State research ultimately will solve the phorid fly problem -- although he thinks it may take a few years. And solutions are critical, he noted, because Pennsylvania leads the nation in mushroom production. The state's 67 mushroom farms last year produced 586.5 million pounds of mushrooms, representing 64 percent of domestic mushroom production.

The research team from the Entomology Department has been studying the problem for several years, according to team leaders Tom Baker and Nina Jenkins. They are taking a multi-pronged approach to solving the problem, seeking to provide relief to residents in the short term and eventually prevent mushroom phorid fly populations from building up in mushroom houses.

"We are trying to come up with something as soon as possible," said Baker, Distinguished Professor of Entomology and Chemical Ecology. "We're taking a comprehensive approach that involves both long-term solutions dealing with the fly larvae, while at the same time, trying to devise some short-term remedies inhibiting the movement of adult flies."

The mushroom phorid fly problem was triggered in 2012 when the U.S. Environmental Protection Agency ruled that an insecticide mushroom growers had used successfully for decades to control the pest -- diazinon -- could no longer be used in mushroom production because of its toxicity. "Mushroom farmers now have nothing they can use to control these flies," said Jenkins, research associate in entomology.

"There are a number of chemical products that could be effective in killing the larvae that can't be used with mushrooms because they are not permitted by the EPA for use in mushroom crops. It is a complicated challenge because anything that you add to the compost can be taken up by the mushroom."

Researchers are testing biopesticides that have been registered for use with other crops but could have potential for controlling larval development in mushroom compost, Jenkins said. She called it "a long shot" but explained that it could be relatively easy to have a biopesticide's label extended for use in mushroom production if one was found to be effective at halting development of phorid fly larvae.

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Baker mentioned a number of strategies under consideration to reduce adult phorid fly movement that hold promise for giving relief to residents. But none likely will be employed in the near term until they have been evaluated this summer and fall by researchers.

The strategies include low tech methods -- improvements in screening and sealing of cracks and gaps in walls between growing rooms and in outside walls of mushroom houses -- as well as novel technology such as installing pesticide-treated "eave tubes" developed originally by Penn State entomologists to channel and kill malaria-carrying mosquitos in Africa. Researchers also will investigate complex chemical ecology efforts, such as deploying pheromones to confuse male flies and prevent them from mating.

To intensify and expedite experiments, researchers established a mushroom phorid fly colony at the Penn State Mushroom Research Center. It is likely the only such experimental colony in the world, and maintaining a consistent and active colony has been surprisingly difficult, Jenkins admitted. However, the effort has paid dividends.

"We started from zero with no clues, but we have been able to make progress on getting a pheromone identified, and we think we are very close," Baker said. "The reason that this is important is that we would like to be able to perform mating disruption, which has been successful in many other insects in field crops, apple orchards and in other agricultural applications around the world that I have been involved with."

If the pheromone disorients male phorid flies inside the mushroom-growing rooms, they can't mate with the females during the period when they emerge, Baker explained. That would keep the population from building up inside mushroom houses. If the populations of adult flies can be kept low through the early part of the year, then the problem of so many flies invading the residential areas could be prevented.

"We are still not quite sure why the flies are so keen to get out, but they are," Jenkins said. "We have had a Ph.D. student working with mushroom growers and residents over the past two years, providing them with traps and tracking the flies' movements."

She cautioned that long-term solutions will not come quickly. Even a label extension of a biopesticide will take a year to get through the Environmental Protection Agency, and EPA scientists will require all the data to support that beforehand. Because Penn State has enjoyed complete cooperation from the mushroom industry and unlimited access to mushroom houses, the timeline could be compressed slightly.

"We are only now starting to see whether anything even has an effect, so we have a lot of testing to do. Even if we find something that looks very promising, after we demonstrate efficacy, we also have to do toxicity testing -- because whatever you add to the compost could impact the mushroom crop."

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