Incognito caterpillar threatens US borders

Faster identification could help officials protect the country's crops from invasive Old World bollworm.

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26 August 2014

An article from Scientific American.

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The Old World bollworm is a notorious menace to farmers in Europe and Asia, and it is now spreading across North America, where it is easily confused with its relative the corn earworm.

One of the worst insect pests in the world is coming to the United States — and it's coming in disguise. By almost any measure of pest severity, the Old World bollworm *Helicoverpa armigera* tops the charts. Annual losses from the pest are estimated at $5 billion. The caterpillars eat more than 180 kinds of plants including cotton, corn, soybeans, citrus fruits and ornamental flowers. A single female can lay thousands of eggs, and adult bollworm moths can ride wind currents up to 2,000 kilometres[1] — about the distance from Mexico City to Albuquerque, New Mexico. Yet the invasive pest looks identical to a common North American species called the corn earworm *Helicoverpa zea*, which has made the task of finding and stopping the newcomers appear nearly impossible.

Until recently the Western Hemisphere has been free of Old World bollworms, which have confined their depredations to Africa, Eurasia and Oceania. In 2013, however, Old World bollworms were found attacking tomato and soybean crops in Brazil[2]. Since then the species has been spotted in Argentina and Paraguay; researchers believe it is likely to spread north. "It can tolerate a wide range of environmental conditions, it can eat lots of different hosts and it can fly great distances. So there is no reason why it won't move up through Mexico," says Tom Walsh, research scientist at Commonwealth Scientific and Industrial Research Organization and one of the researchers who first identified Old World bollworms in Brazil.

With the naked eye, the newcomer cannot be distinguished from the corn earworm, making identification impracticable at border customs checks and difficult during in-country surveys. The US Department of Agriculture (USDA) is funding the development of a new

method of quick identification to keep the invaders out as long as possible. If bollworms do make it to the US, they could be very hard to kill. The species has developed resistance to more insecticides than any other targeted insect, according to the USDA.

The chief remaining arrow in the pesticide quiver is *Bacillus thuringiensis* (Bt), a naturally occurring soil bacterium used as a pesticide. Bt toxins still work on bollworms, but possibly not for long. Researchers have no trouble breeding Bt-resistant bollworms in the lab, and resistant individuals are regularly found in the wild. Farmers in Asia and Australia go to great lengths to delay the spread of Bt resistance, but farmers in South America do not. This could cause trouble, because farmers in both North and South America rely heavily on crops that have been genetically modified to produce Bt toxins. By the time bollworms make it to the US, they could already be resistant. “The really scary part about the potential of [Old World bollworms] moving into the United States is that they will be coming from a place where they’re going to be selected intensely for resistance to Bt toxins. So we’re unlikely to get [bollworms] that are susceptible,” says Bruce Tabashnik, professor of entomology at the University of Arizona in Tucson.

USDA officials are trying to stop the bollworms from establishing populations in the country, but first they must find them. Entomologists can distinguish adult moths by their genitals, but only after laborious dissections. Caterpillars have no genitals and can only be identified by their DNA, which takes about a week with traditional methods. “The problem is that you can’t take a week to get an answer if you are holding up a perishable shipment of fresh produce, like oranges or tomatoes,” says Todd Gilligan, research scientist at the Department of Bioagricultural Sciences and Pest Management at Colorado State University. Gilligan has developed a new identification method that takes just 45 minutes.

The new method works by targeting a sequence of DNA that is the same for all Old World bollworms but different in other species. The researchers produce lots of copies of this sequence using a reaction called PCR. Normally, the product of the reaction must be sent to a different lab for analysis, which accounts for most of the weeklong processing time. But Gilligan and colleagues eliminated this step by using a technique known as real-time PCR. With this method, the target DNA triggers a tiny fluorescent flash each time it is copied, allowing researchers to see results as they happen. “I can give you an answer in 45 minutes or less. Once I start seeing this pattern versus that pattern, I can cut this thing off in 30 minutes and tell you exactly what’s going on,” Gilligan says. He presented his method at the 2014 meeting of The Lepidopterists’ Society.

The USDA funded Gilligan’s research primarily because it needed a faster way to identify adult moths caught during surveys. If the moths do make it into the country, officials will need to track their spread and target budding populations. The USDA, however, is also looking at using molecular methods like Gilligan’s to identify caterpillars at US ports of entry, according to Joel Floyd, a domestic diagnostics coordinator with the USDA Animal and Plant Health Inspection Service.

More research has to be done before the new method can be implemented. The USDA will need to confirm its effectiveness, and Gilligan wants to test it with additional specimens and related species. But if the method works, it could be just what we need to see through the Old World bollworm's disguise.

Nature | doi:10.1038/nature.2014.15775

References

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