DNA – a new tool for insect identification

This technology should prove to be a valuable aid to taxonomists and will be a major resource for plant exporters

By Graeme Murphy and Hannah Fraser

There are approximately one million described species of insects in the world. The word "described" does not refer to a verbal description of its colour, shape, size, etc. (although it can include such things), but to the fact that an entomologist has examined specimens of the particular insect, decided where it fits into the insect world and what other insects it is most closely related to. They have then given it one of those two-part Latin names (e.g. *Myzus persicae* = the green peach aphid) that forever after distinguishes it from other living organisms.

There is a great word that Graeme's son Ben brought home from school one day. No, not that sort of word. "Ullage" is the amount by which a container falls short of being full – the empty space in the half drunk glass of wine. For insect species, the "ullage," (the empty space of new species that we don't have names for) is estimated most often at somewhere around 10 million species, but I have seen estimates many times higher than that. And with a worldwide shortage of taxonomic entomologists (those who decide where insects fit into the insect world), it is unlikely that we will be filling that glass of wine to the top any time soon.

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One million is a very approximate number. No one knows for sure how many insects have been described and there is no centralized database of insect names that allows us to easily add them up. An additional problem is that early on in the days of insect-naming, entomologists in different parts of the world (or even in the same country) were describing insects (often the same insects) concurrently, so we would finish up with the same insect having two different names (synonyms). Over the last 150 years, there are many insects that have been renamed on a number of occasions, as synonyms were realized or taxonomy became better understood. An even more approximate number is that of the insects which are still to be described.

Recently, new technology has been developed that should prove to be a valuable aid to insect taxonomists (and to those taxonomists who study other animals as well). We are all probably familiar with the concept of DNA as a tool for solving crime, and identifying individuals from others of the same species. A few years ago, a scientist from the University of Guelph developed a method of distinguishing individual animal species from each other by looking at their DNA. Dr. Paul Hebert identified a gene (used in cell respiration) that is common to all animal species, but is slightly different in each species; different enough that it can be used to tell them apart.

The DNA analysis has the superficial look of a barcode, which has given rise to the project name, the Barcode of Life. The work has many implications for various animal species – fish, birds, snakes – but its implications for greenhouse pest and disease identification is what got us excited.

It has to be realized that DNA identification of species is not a replacement for the traditional methods that have been in use until now. Generating a DNA barcode for an unknown insect means little, without a positive identification of the species using traditional methods. However, once we can assign a barcode to a known species, identification from that point on can be very rapid, and would not require the expertise of trained taxonomists, leaving them with more time to deal with the "ullage" of unknown species.

There are other benefits. Only a small amount of tissue is needed to generate a barcode. A leg, or antenna, or even the smeared remains off the windshield of your car is all that is needed. It doesn't even need to be an adult, which is usually required in traditional taxonomy. An insect larva, pupa or even an egg can be identified to species just as easily.

This opens up many possibilities. In greenhouses, there are a limited number of insects that we have to deal with in crop production and identifying the common ones is relatively easy. However, the industry is also faced with issues in exporting plant material to the U.S., and there are always concerns at the border about potential quarantine pest species that may accompany the plants. Without on-site expertise, identification of common pests can take several days resulting in heavy financial losses in a perishable commodity such as flowers. The availability of a database of DNA barcodes of common insect pests opens up the possibility of rapid identification of pests and financial savings to the industry.

All of which has led to an OMAFRA/University of Guelph project to develop a database of DNA barcodes for common Ontario agricultural pests. Spearheaded by Dr. Bob Hanner from the university and the authors of this article, and with collaboration from Agriculture and Agri-Food Canada in Ottawa, the project hopes to have close to 300 insect and mite species in the database by the end of 2007. All major greenhouse pests will be included, as well as all commercially available biocontrol agents. Samples collected will be sent to AAFC for traditional identification, while a small piece of tissue from the same sample will be used for the DNA analysis.

The effort is a small step in catching up to the one million species that have been described so far, but it is a necessary one. If we think of having to get DNA barcodes for that many species we will give up in despair before we even start, but if we look at small chunks of economically important pests and the benefits of having that information, then the task does not look as daunting.

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