Combating pest termites in Malaysia through innovative measures

Researchers

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INTRODUCTION

A recent study has determined that the Asian Subterranean Termite (AST), *Coptotermes gestroi*, is on the rise. *C. gestroi* is a pest that commonly attacks urban structures, such as homes and buildings in Southeast Asia (Figure 1), and is fast spreading to other parts of the world. It is an exotic pest in Australia, Brazil, Puerto Rico, Italy and the Mediterranean, while closer to home, the termite appears to be rapidly outplacing other termites as the main urban termite pest species (Kirton & Azmi, 2005). With this in mind, entomologists at the Forest Research Institute Malaysia (FRIM) are researching on solutions for the housing and building sectors in Malaysia in order to reduce the incidences of termite attacks in urban areas. This has been made possible through a grant provided by the Ministry of Science, Technology and Innovation or MOSTI (Project number: 06-03-10-SF0155). As the housing industry is one of the emerging area of businesses that was identified under the Greater KL/Klang Valley Plan and is a National Key Economic Area for Malaysia heading into 2020, FRIM hopes to lend the expertise of its scientists in finding solutions to the threat posed by wood–destroying termites, particularly within the state of Selangor where the housing sector is set to expand into the year 2020.

Figure 1. An example of a severe infestation of *C. gestroi* in a building, where the structural beam has been completely eaten away.

OUR RESEARCH

Researchers at FRIM began their study by carrying out an area–wide survey of the state of Selangor, in order to identify areas prevalent with *C. gestroi*. Museum collections of *C. gestroi* in FRIM's entomology collection were examined, and data such as the locality and the nature of these infestations were recorded. In addition, an internet–based survey was carried out between the months of July 2012 and February 2013, targeting respondents within, but not restricted to, the state of Selangor. The town and city councils within the state hosted the online questionnaires, available to the public in both Malay and English. The survey was also advertised in a local daily, The Sun, in July 2012. We even gave away a number of limited edition t-shirts to participants to express our gratitude. Congratulations to those lucky individuals!

Respondents were required to answer a number of questions regarding the nature of termite attacks in their area, such as the type of building attacked, the part(s) of the building damaged by the attack, whether the building was situated within close proximity to a wooded area, and when the attack had occurred. To help identify the areas susceptible to termite infestation, the location of each attack was plotted on a map (Figure 2). Additionally, researchers collaborated with RidPest Sdn. Bhd., a well-known pest control operator in Malaysia, in surveying infested

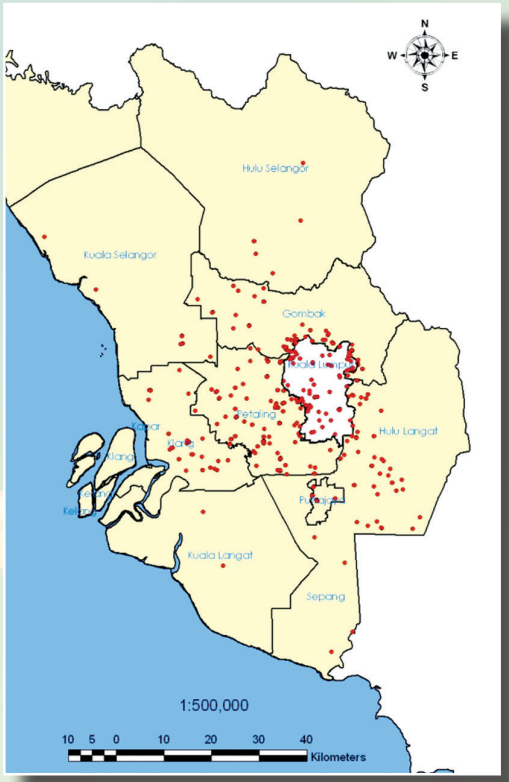

Figure 2. Termite infestation map of the state of Selangor (a red dote indicates a home or building where infestation has taken place)

premises in the Klang Valley, where our technicians collected data and samples from affected home owners.

We also have an on-going experiment to determine the swarming seasons of termite species in Selangor, with particular reference to *C. gestroi*. A key feature in this experiment is the use of light traps which were installed at various places within the FRIM campus (Figure 3).

Figure 3. A light trap used to collect termite alates in FRIM.

Figure 4. A technician at FRIM collects termite alate samples obtained from our light trap every morning.

Our technicians and scientists have been monitoring these traps for termite alates since October 2012, with the experiment set to continue until the end of October 2013 (Figure 4). This year–long experiment aims to identify specific times of the year when *C. gestroi* alates swarm to produce new colonies. By identifying the swarming seasons of *C. gestroi*, a simple and effective method of suppressing the growth and formation of new termite colonies can be devised. Light traps can be positioned in the parts of Selangor that are heavily affected by termites. This will suppress the formation of new colonies of *C. gestroi* and will decrease the rate of new infestations over time. The method of trapping alates is generally aimed at *C. gestroi* which is the primary urban pest in the country. The majority of other termite species are in actual less destructive to homes and buildings. In addition to this, these termites are known to suppress *C. gestroi* colonies through competition for resources. Hence, promoting termite diversity in urban areas may help us in managing populations of *C. gestroi*.

Taxonomic identification of termite alates is however difficult to achieve using morphological characters, that is, through the structural features of the termite, such as the size and shape of the mandibles and/or head capsules. In addition, morphological identification keys for termites are mostly based on soldiers. Hence, we utilised DNA barcoding to determine the taxonomic identity of the termite alates. The flowchart below summarises the main steps of a DNA barcoding experiment (Figure 5).

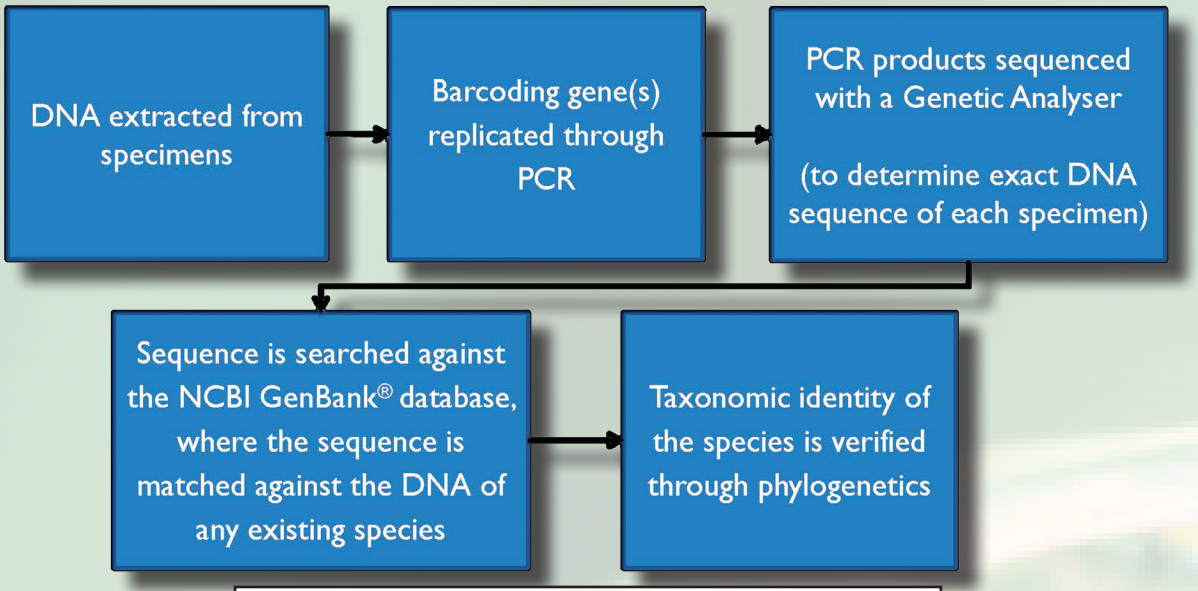

Figure 5. The method of a barcoding experiment

In our DNA barcoding experiments, we sequenced partial fragments of two mitochondrial DNA genes, that is, 16S ribosomal RNA (16S rRNA) and cytochrome oxidase subunit I (cox1) which are commonly used for species identification and can be amplified using a polymerase chain reaction (PCR) approach. In this method, DNA is extracted from the termite alate (Figure 6), and universal primers are used to amplify them via PCR.

Figure 6. Researchers from FRIM and Universiti Malaya performing DNA extractions.

The gene(s) is subsequently purified and sequenced before they are identified by performing a query against DNA sequences available on public DNA databases.

The database we used in our experiments was the National Centre for Biotechnology Information's (NCBI) GenBank® database. GenBank® is part of the International Nucleotide Sequence Database Collaboration, which has in its repository DNA sequences for almost 300,000 described species. When our termite alate DNA sequences are queried against the GenBank® database using BLAST (Basic Local Alignment Search Tool), their identity can be matched to DNA sequences of identified termites in the database. The availability of DNA sequences of termites from GenBank® from Southeast Asia, in particular, allows us to reconcile the identity of our alate DNA sequences with identified DNA sequences of termites in the database.

The different castes or forms of termites such as workers, soldiers or alates are merely the different phenotypes found within a colony. Their genetic make–up, with reference to their mitochondrial genome, is however identical. When the worker, soldier or alate castes are barcoded by sequencing the 16S rRNA or the cox1 genes, the DNA sequences obtained from any one of these caste members will be identical. This removes a major barrier for the termite researcher who is almost always dependent on soldier specimens to identify a species, making it possible to identify species from workers or alates when it is the only form collected or encountered.

HOW YOU CAN HELP!

According to the results of the survey conducted between 2012 and 2013, termite attacks occur most frequently in terrace houses, most of which have a garden and/or a wooded area within 1 kilometre of the property. We are in the midst of completing our analyses to identify areas most affected by termites in the state of Selangor and determining the exact periods when pest termites come into swarm which will be made available to you in our next research update. Should you identify your area as being susceptible to termite attacks, you may want to consider writing to your local town or city council requesting for the installation of light traps in the area.

Another method to prevent termite infestation is through the use of termite–resistant timber species in homes and buildings. There is also the growing trend of using engineered wood or wood-plastic composites (WPCs) for use in homes and buildings. However there is a need to determine if these materials are able to resist attack from tropical termites. If these materials prove to be resistant, they can be used as a substitute for features prone to termite attack such as door frames, kitchen cabinets, wall skirtings or in the case of WPCs, boardwalks, decks and fences. The attractiveness of WPCs is that it utilises wood waste and plastic as its main constituents. In addition to this, WPCs are water–resistant, easy to maintain and recyclable.

FINAL REMARKS

A summarised version of this article will appear in the December 2013 issue of FRIM in Focus. If you are interested in our project, do write to us. We also aim to release a second newsletter later in the year, updating you on our progress. So, stay tuned!

FURTHER READINGS

Kirton, L.G., and Azmi, M. (2005) Patterns in the relative incidence of subterranean termite species infesting buildings in peninsular Malaysia. Sociobiology 46.1 2005: 1-15.

Schleifstein, M. (2013) French Quarter residents are on their own after federal Formosan termite treatment program ends. The Times-Picayune Greater New Orleans. May 14, 2013 Available online at <http://www.nola.com/environment/index.ssf/2013/05/french_quarter_ residents_on_ow.html>

GLOSSARY

alate(s): The winged or reproductive caste of termites.

entomologist(s): A zoologist who specialises in the study of insects.

***Coptotermes gestroi (C. gestroi)*:** A pest termite species, increasingly infesting homes and buildings in Malaysia and Singapore. It was previously referred to as Coptotermes havilandi.

DNA barcoding: A taxonomic method that uses a short genetic marker in an organism's DNA to identify it as belonging to a particular species.

light trap: An insect trap that attracts and traps insects through the use of light.

mitochondrial DNA: DNA located in mitochondria (structures within cells that are responsible for converting energy into forms that are useful to the cell it inhabits).

polymerase chain reaction (PCR): A laboratory technique used to replicate or amplify a DNA fragment.

primer(s): A short strand of nucleic acid that is required in carrying out DNA replication.

swarming season(s): The time of year when termite alates leave their nests to start new colonies.

taxonomic identification: The identification of organisms on the basis of shared characteristics.

wood–plastic composites (WPCs): Composite material made from thermoplastics and wood fibres. Often, they are made from recycled and waste products such as rice husks, wood chippings and reclaimed plastic. They have many beneficial properties, including being resistant to termite infestation.