

Spider man in the hunt for a safer insecticide

An Australian researcher is developing a new natural insecticide from spider venom that is deadly to insects yet harmless to humans, animals and the environment.

Professor Glenn King from the University of Queensland's Institute for Molecular Bioscience has isolated insect-specific neurotoxins from the venom of Australian funnel-web spiders.

'Spiders are the most proficient insect killers on the planet, so we decided to investigate how their venom works,' says King.

Unlike synthetic pesticides, the spider-derived compounds do not contain harmful chemical groups such as chlorides or halogens found in DDT.

King chose the funnel-web spider because earlier work carried out by a group at Deakin University had demonstrated the efficacy of funnel-web venom against cotton bollworm, a crop pest known to be resistant to most insecticides.

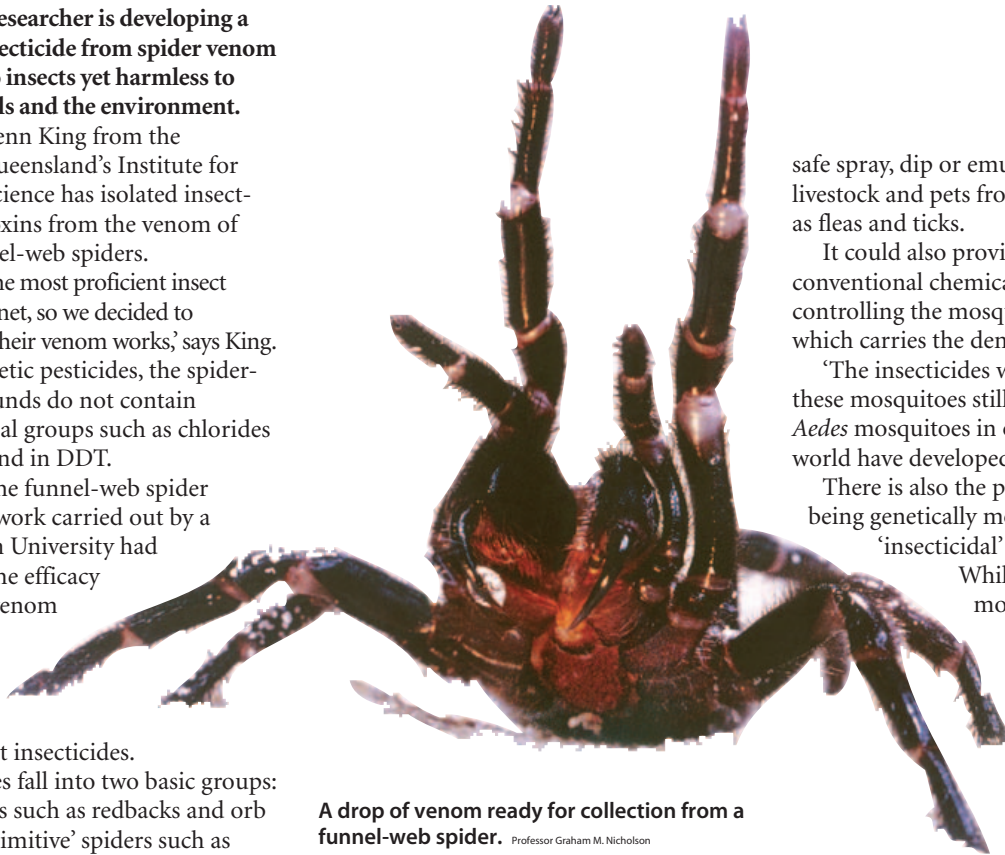
Spider species fall into two basic groups: 'modern' spiders such as redbacks and orb weavers, and 'primitive' spiders such as tarantulas and funnel webs. The Australian funnel-web spider is the only primitive spider known to be harmful to humans.

'About 40 000 spider species have been characterised and of these only four families are deadly to humans – they include the funnel-web and redback spiders,' says King. 'So most spiders are harmless to humans but they all kill insects.'

As King points out, spider venom is a chemical cocktail of many hundreds of different compounds.

'Of the thousand or so compounds in funnel-web spider venom, only one is responsible for killing humans. Most of the others are completely harmless.'

King's team was able to identify the neurotoxins – small chains of amino acids known as peptides – that target insects' nervous systems but are non-toxic to vertebrates. They used chromatography to isolate different venom components and also compiled libraries of DNA



A drop of venom ready for collection from a funnel-web spider. Professor Graham M. Nicholson

sequences from funnel-web spider venom glands.

Using *in vitro* peptide synthesis, the researchers were then able to separately produce and test the individual peptides encoded by these DNA sequences.

Apart from the potency of its venom, the funnel web is long-lived, making it suitable for laboratory based research.

'Female funnel-web spiders and tarantulas can live for more than 20 years,' says King.

'Our collaborator, Professor Graham Nicholson at the University of Technology, Sydney, has kept female funnel-web spiders in captivity for five years or more, providing a consistent supply of venom for biochemical and structural analysis.'

King believes the natural insecticide could be developed into an effective and

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safe spray, dip or emulsion to protect livestock and pets from ectoparasites such as fleas and ticks.

It could also provide an alternative to conventional chemical insecticides for controlling the mosquito *Aedes aegypti*, which carries the dengue fever virus.

'The insecticides we currently use on these mosquitoes still work well here, but *Aedes* mosquitoes in other parts of the world have developed resistance to them.'

There is also the prospect of crop plants being genetically modified to produce the 'insecticidal' peptides.

While current genetically modified insect-resistant crops are effective against a narrow range of insects, the venom-derived peptides have proved effective against a broader range of insects.

According to King, the use of insect-resistant transgenic plants could reduce pesticide use and harmful chemical residues left behind on raw food products and in the soil.

Ironically, it's the harmlessness of insecticides from spider venom that may be their strongest selling point commercially.

'These compounds are really specific in targeting only insects,' says King. 'They have been tested on a range of vertebrates such as mice and rabbits, and have proved non-toxic to these vertebrates.'

● Mary-Lou Considine

More information:

Tedford HW, Sollod BL, Maggio F and King GF (2004). Australian funnel-web spiders: master insecticide chemists. *Toxicon* 43(5), 601–784. <www.sciencedirect.com/science/journal/00410101>