A deadly scorpion provides a safe pesticide

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Scorpions deliver a powerful, paralyzing venom — a complex cocktail of poisonous peptides that immobilize animal prey on the spot. Some of the toxins in this cocktail damage only insects, which is why a Tel Aviv University researcher is harnessing them to create a safe and ecologically sound pesticide.

Prof. Michael Gurevitz of Tel Aviv University's Department of Plant Sciences has isolated the genetic sequences for important neurotoxins in the scorpion venom. He's also developed methods to produce and manipulate toxins to restrict their toxicity in certain insects or mammals.

"Two decades ago I realized that scorpion venom is a goldmine for possible insecticidal and therapeutic agents. This raised the question of how to use them as ecologically-safe agents against insects in a farmer's fields, or in medicinal disorders," he says.

In his study of the toxins and the evolution of their genes he recently published a paper in the journal *Molecular Biology and Evolution* that demonstrates how computational analyses at the gene sequence level leads to better understanding of how to manipulate toxin activity.

A venom factory in the lab

Rather than isolating the venom constituents of the Israeli yellow scorpion, known to be among the world's most poisonous scorpions, Prof. Gurevitz developed genetic methods for producing and manipulating the desired toxins in bacteria. He then investigated how

they act against insects and mammals, paving the way for potential use in the agriculture industry.

He went in this direction because attempts to insert a certain neurotoxin gene into a plant genome hoping for the plant to produce the toxin and kill infesting insects has failed. As a peptide, the toxin was metabolized in the insect guts, which evidently seems to require that it first be engineered to be able to penetrate into the insect blood stream to have its impact on the nervous system.

Prof. Gurevitz says that some neurotoxins in the scorpion are highly active against some insects — leaf-eating moths, locusts, flies and beetles — but have no effect on beneficial insects like honeybees or on mammals like humans. He continues to pursue an effective mode of delivery for what could be a new insecticide.

Prof. Gurevitz is considered one of the world's pioneers in this field, having published numerous papers on this subject. He spent six years as a research fellow at Washington University in St. Louis and Michigan State University, beginning his scorpion studies while an M.Sc. student in Jerusalem 35 years ago. Since then, he's developed methods of toxin gene cloning, production and modification in his lab, paving the way for an entirely new molecular field based on the venom of the deadly insect.

A "Trojan crop" to hide a deadly poison

Since scorpion toxins must be modified to be able to penetrate the blood stream of an infesting insect, it is important to study the toxins and the way they interact with the insect nervous system. Only then would it be possible to modify them in such a way as to reach their target tissues in insects, he says. This is the direction he is working on now.

The agriculture industry already uses mostly pyrethroids, which also

penetrate into insects and attack their nervous systems, leading to paralysis and death. Their main drawback, however, is the lack of specificity and the danger these compounds pose to the environment, livestock and humans.

"Why not harness potent natural compounds that venomous animals developed during millions of years of evolution?" asks Prof. Gurevitz. "I am developing the science so we can learn how to use them, and to learn how to produce agents to mimic their effect yet maintain specificity to certain kinds of insects."

Provided by Tel Aviv University