Greener pest control

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Scientists plan to fight insect pests by turning their own hormones against them

An international research project funded by the EU's Horizon 2020 program will develop new pest control methods that neither cause environmental pollution nor harm beneficial insects.

The economic cost of agricultural pests is extremely difficult to estimate, but biological threats such as insects and disease account for around 40% of all crop losses globally. The rising need for food worldwide necessitates ever more effective methods in the fight against agricultural pests. By 2017, the world is expected to spend more than 65 billion USD annually on pesticides. At the same time, there is a pressing need to develop "greener" pesticides that target damaging insects while sparing beneficial ones. An international consortium of scientists, including participants from the Institute of Zoology at the University of Cologne headed by Professor Reinhard Predel, is hoping to develop new, eco-friendly pesticides that will render numerous pest insects less destructive. Horizon 2020, the EU's research and innovation fund, has granted 7 million euros to the project nEUROSTRESSPEP, which will study developments in the hormone systems of selected insect species. The researchers are aiming to influence these systems with artificial hormone-like substances, so called peptidomimetics. Neuropeptides are a highly adjustable group of hormones that help the brain and tissues communicate with each other. The project will be launched in June and run for four years.

"At the Cologne Biocenter, we have outstanding conditions for structural clarification and only need a single specimen of an insect to be able to identify up to 100 neuropeptides found in the species," Predel explains his institute's role in the project. "These questions perfectly fit into our research focus." The pests being targeted in this study include moths, locusts, aphids, flies and beetles, which either damage crops directly through eating, or indirectly by spreading plant viruses.

Traditionally employed pesticides are poisons that make no difference between damaging and beneficial insects or spiders. Moreover, despite the use of these chemicals, individual specimens of the insects generally survive and grow resistant to the pesticide. Their natural predators are often affected much more severely because they exist in significantly fewer numbers. As a result, in the next generation the insect population explodes because the number of natural predators has been diminished. "Our goal is to reduce the fitness of the damaging insects to prevent a population explosion," Predel says. Other insects are not affected. "We will be able to specifically target the insect whose population we want to diminish; the relation between natural predator and insect remains unaltered and beneficial insects such as honeybees are no longer harmed."

To develop artificial neuropeptides, the researchers have to identify the natural prototypes. "We will investigate if the species in question have unique specialized systems. In short: we want to use the unique nature of the species as the point of application." Neuropeptides are very well suited for this strategy, as species often have unique neuropeptide sequences. Once the scientists have identified these sequences, they can develop structurally similar artificial messenger substances and stabilize them in such a way that the insects cannot break them down quickly. "If these artificial hormones cannot be broken down, the organism is destabilized. Its water balance, reproduction and nutrition intake are disturbed."

The neurobiologists from the University of Cologne are at the beginning of the international consortium's work process. "We identify the specific hormone systems of the harmful insects and correlate them with those of beneficial insects such as honeybees to ensure that they do not overlap," Predel elucidates. The results are then passed on to other groups who study the functions of the identified hormones in detail, synthesize structurally similar substances, test applications and explore possible commercial uses. At the end, the specimens return to Cologne once again. "We then check whether the application of artificial hormones has led to noticeable changes in the natural hormone balance of the harmful insect. Other species should not display these sorts of changes."

nEUROSTRESSPEP is coordinated by the University of Glasgow and involves 12 partners from research, politics and industry: Katholieke Universiteit Leuven, Universitat Gent, the Agricultural Research Organisation of Israel, Stockholms Universitiet,

University of Cologne, University of Leeds, The Scottish Government, Forestry Commission Research Agency, University of Cape Town, Bruker Daltonik GmbH, Pirbright Institute LBG, Oxitec Limited and Knowledge Transfer Network Limited.

Media enquiries:

Professor Reinhard Predel

University of Cologne

Faculty of Mathematics and Natural Sciences

Institute of Zoology

Neurobiology/Animal Physiology

Phone: +49 (0) 221 470 5817
Email: reinhard.predel(at)uni-koeln.de

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