GENOME BOOST FOR NATURE-FRIENDLY PEST CONTROL

New open resource will accelerate research towards better targeted crop protection

A new database of 19 insect genomes encompassing some of the most damaging pests of crops worldwide has been made publicly available. It includes some of the most common pest threats faced by UK farmers including wireworm, cabbage stem flea beetle and pollen beetle, as well as other globally important species.

It is hoped that the new database will help speed up the development of novel pest control approaches that can overcome resistance and create more nature friendly solutions to crop protection.

The four-year Pest Genome Initiative (PGI), a consortium of Rothamsted Research and the agriscience companies Syngenta and Bayer, firstly sequenced the genomes, and then assembled them into their constituent chromosomes before adding information about what individual genes code for.

Benefits of the project

The team say their efforts will help in the development of crop protection products that are more species-specific and overcome the problem of resistance. They will also help develop non-chemical pest control methods, such as manipulating insect behaviour; focusing on the genes that control how insects find mates and host plants and hence shepherd them away from crops.

Before the research team set to work, detailed genomes had been assembled for only a handful of the planets one million plus insect species – and even fewer of these were crop pests.

The team say their efforts will also help in the development of pesticides that are less likely to incite resistance evolving in their target species – a huge problem for farmers and often the reason for excessive pesticide use.

Rothamsted's Professor Linda Field, one of the research leaders, said the future of farming would be 'smarter' and involve less pesticide use: dovetailing the electronic surveillance of insect movements and measures that encourage natural pest control, with these newer, more targeted pesticides.

She said: "Currently as much as a fifth of all crops are lost globally to pests, and this is predicted to increase to 25 percent under climate change. Whilst non-chemical control methods can have some success in reducing crop losses, pesticides remain a necessary weapon in our fight against devastating crop losses and will so for the foreseeable future."

Target specific pesticides

Pesticides have long been implicated in wider biodiversity declines, most notably with the impact some neonicotinoids have on bee populations, leading to the subsequent banning of these pesticides in Europe.

By assembling these detailed genome 'maps' of annotated sequences, researchers can start to develop the next generation of pesticides – ones that very specifically target the pest whilst leaving other species unharmed, said Professor Field.

All the pests included in the Pest Genomics Initiative are well known for attacking vitally important crops worldwide, including oilseeds, vegetables, cereals, fruits, beans, sugar and cotton.

The hope is that by having these higher quality genomes available, researchers will be able to better understand how resistance to pesticides evolves – and it will also improve their understanding of insect chemical communication channels, opening up the possibility of non-lethal control methods that 'hijack' insect behaviour.

"Understanding the pests' genes means we can understand the specific proteins they make. By comparing these proteins to the proteins made by non-target species, we can tailor control methods that only work on pests. Examples include those proteins that allow pests to de-toxify pesticides, the basis of much evolved resistance."

Another exciting area for research will be into the genes involved in insect behaviour, the so-called odorant binding proteins and receptors, which allow insects to find mates or host plants. she added.

"If we can produce products that target those, we can potentially manipulate pest behaviour and shepherd them away from the crops."

A further use for these genome sequences is in identifying insect species that have the potential to switch diets to feed on other crops – something that may become an issue in certain countries as pests migrate or new crops are grown as the climate changes.

The genomes will also be an important resource for the wider entomological community studying insect evolution, physiology, biochemistry and ecology.

In recognition of the fact that the future of pest management will involve both better targeted chemicals and other techniques, the project also assembled the genomes of three beneficial insects, the European hoverfly, and the pirate bug, both of which predate crop pest species, as well as a species of parasitoid wasp that lays its eggs inside the crop pest, the cabbage stem flea beetle.

Professor Field said: "It's important we understand differences between insect species, so that we can both protect crops from pests and conserve beneficials.