CRC PLANTbiosecurity

MEDIA RELEASE

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Gene search into the secrets of a super-bug crop destroyer

The genetic make-up of one of the world's most devastating crop pests, the Russian wheat aphid, is being analysed as part of a sophisticated biosecurity effort to protect Australia's wheat industry – and the numerous regional communities it supports.

Australian researchers are part of an international consortium that is sequencing the genes of aphids in a bid to eventually breed wheat varieties that have long-term resistance to the pest.

Australia's wheat industry is worth almost $5 billion annually and Australia is the only major wheat-growing region of the world currently free of the pest, which can wipe out entire crops. Both barley and wheat are affected.

So destructive is the pest that none of the aphids can be brought into the country even for research purposes. Instead, Australian scientists are relying on their international partners to assist them in studying this insect. Australian researchers are also using the pea aphid as a surrogate for their local research.

CSIRO entomologist Dr Owain Edwards is leader of a Cooperative Research Centre (CRC) for National Plant Biosecurity project to develop Australia's response to any incursion by the Russian wheat aphid.

Dr Edwards says since the 1970s the aphid has spread rapidly through the major wheat-growing regions of the world from the Middle East and Balkan states where it appears to be endemic.

"It causes major crop destruction for the first five to seven years after it appears in a new region, until the ecosystem establishes a balance, with occasional outbreaks causing ongoing problems.

"It remains a major pest in the US and South Africa. These countries spent 10 years developing and rolling out resistant wheat varieties, but all of the original resistant wheats relied on a single resistance gene. Within six or seven years the aphids evolved to overcome that resistance," Dr Edwards says.

His research involves genomic sequencing of the salivary glands of the aphids, in an attempt to map how they evolve to secrete new forms of proteins – proteins that wheat plants no longer recognise as precursors to attack. Dr Edwards says the changes in aphid saliva indicates a rate of evolution 50 to 100 times faster than that of other insects.

When aphids attack a resistant plant, the plant detects particular proteins in the aphid saliva and cuts off the flow of sap to that part of the plant. Finding no sap, the aphids leave the plant and fly on to neighbouring plants.

Tasting is the primary mechanism aphids have for identifying their food. If, after several attempts to feed, they are unsuccessful, they can launch themselves into the air currents and can travel hundreds of kilometres in search of a new food source.

In non-resistant plants, the wheat does not recognise the protein and allows Russian wheat aphids to feed without triggering any defence mechanisms. This results in white streaks on the wheat leaves – symptoms similar to drought stress. The leaves also curl, trapping the heads of the plants and making it impossible to harvest the grain.

"Contact insecticides are relatively ineffective because the aphids are inside the curled leaves, where the chemicals can't reach them," Dr Edwards says. "It only takes relatively small numbers of these aphids to cause significant damage."

None of the wheat or barley varieties currently released in Australia have Russian wheat aphid resistance, and rolling out resistant varieties from the US or South Africa would be relatively ineffective if aphids arriving in Australia are those that have already evolved to overcome plant resistance.

"Identifying the mechanisms aphids use to generate new proteins and developing resistance to those proteins at a more fundamental level is the strategy we are pursuing. Once we understand the underlying mechanism, the appropriate resistance can be developed for a range of different aphid species and crops," Dr Edwards says.

Collaborators in the CRC for National Plant Biosecurity project include CSIRO, the Grains Research and Development Corporation, and Kansas State University in the US. The Chinese Academy of Sciences will also join the research this year.

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High-resolution images of Dr Owain Edwards and Russian wheat aphids are available to accompany this media release from www.crcplantbiosecurity.com.au/news/media-releases