Terminating the mega-pest: Biosecurity a key to effective IPM

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WHAT do air traffic statistics and the volume of global trade have to do with managing insect pests in Australia? A great deal! That is because increasingly, the whole world is growing the same crops, using the same chemicals to control the pests that attack them, and inevitably spreading those pests globally.

In 2018, eight billion people are expected to travel by aeroplane. Through to 2040, authorities forecast global average growth rates in air cargo of 2.5 per cent, and passenger traffic of 4.5 per cent annually (the equivalent of 22 billion passengers). Predictions are that by 2022 passenger traffic in emerging economies such as Brazil and China will probably be greater than that of advanced economies.

As the volume of global trade, travel and transport expands, the risk of exotic incursions to Australia increases. In 2017, Australian Biosecurity stopped more than 340,000 potential pests and disease-ridden items from entering the country but guaranteeing the detection of pests and diseases at our borders is becoming extremely difficult.

The brown marmorated stink bug was detected in three shipments into Australia in the past 10 months.

Arrivals of new species and different strains of existing species

In August 2018 the Australian Government recognised 18 national pest and disease outbreaks, including red fire ants that entered in 2001 and again in 2006, 2012, 2013 and 2014. These ants are linked to a potential 10 per cent reduction in cropping based on studies overseas.

Of specific relevance to cotton, the brown marmorated stink bug (BMSB) over the past 10 months was detected in two states at three locations in shipments of electrical equipment or bricks from overseas. Although considered eliminated, cotton is one of over 300 hosts BMSB can use. If this pest becomes established it will be very difficult to eradicate.

New incursions of pests and diseases might be different genetic forms of species that already exist. A recent report by CSIRO identified 12 major future biosecurity threats for Australia, with the first a new race of an already existing wheat disease. The cotton industry also recognises the potential threats posed by different races or strains of pests and diseases, which it documents in its Farm Biosecurity Manual and broader biosecurity plans.

Using DNA fingerprinting, researchers found that incursions of different yellow fever mosquito strains could drive insecticide resistance in existing Australian populations. Yellow fever mosquitos intercepted at Australian airports had similar genetic fingerprints to those from South-East Asia. Although Australian mosquitos do not yet carry resistance genes for pyrethroid insecticides, all of the mosquitos from South-East Asia, including those intercepted at Australian airports, do carry genes that make them highly resistant to this group of insecticides.

This risk also extends to agricultural pests. Most

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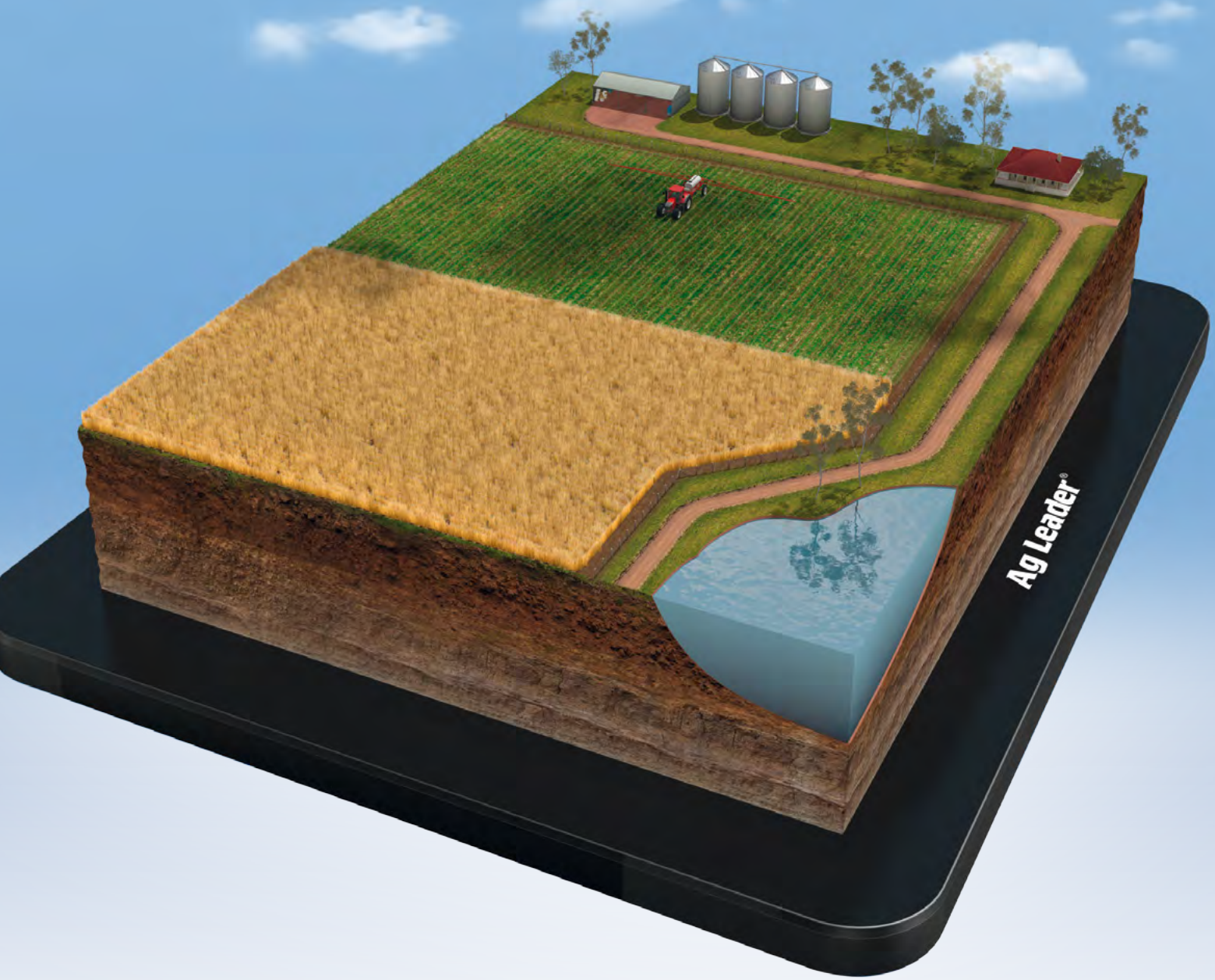

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Australian green peach aphid colonies have recently become multi-resistant to pyrethroids, carbamates, and (some individuals) organophosphates. Within this group there are three clones of individuals that are genetically identical, and the signature of one of these Australian clones matches exactly a sample from China. This finding suggests that these super-resistant strains of aphids have recently arrived in Australia from Asia.

Apart from the incursion of new hybrids, new pests that enter Australia could breed with existing pests to create their own new hybrids. For example, we showed that the recent incursions of *H. armigera* moths into Brazil are hybridising with local *H. zea* moths and exchanging resistance alleles. All of the Brazilian moths examined were some combination of *H. zea* and *H. armigera* genetic signatures, both of which are difficult pests to control and in this hybrid form could have the potential to be even more challenging.

The arrival of a new mega-pest into Australia is within the realms of possibility. For example, in Brazil, *H. armigera* is exposed to over 53 million hectares of Bt crops with no co-ordinated or mandatory plan to manage them. These populations are being selected year-round, with a cocktail of Bt products which contain some of the same Bt traits as those used in Australian cotton. Closer to home, our colleagues in China isolated several types of resistance in *H. armigera* to the Cry1Ac toxin in Bollgard 3, two of which are dominant and unknown in Australia and may improve a larvae's survival on the Cry2Ab toxin in Bollgard 3.

Helicoverpa zea.

How can growers safeguard against the increasing risk of new arrivals?

Australian farmers and growers are operating in an international context where incursions are likely. Although this is daunting, the tactic to best safeguard your business against this threat is to practise good Integrated Pest Management (IPM; Figure 1).

Good IPM has monitoring at its core and is sustained by a strong social framework providing up-to-date reliable information and support. By monitoring known pests, growers can make informed decisions about the most appropriate control method from the IPM toolkit. Monitoring for exotic pests, or different races or strains of known pests, is also key to an effective biosecurity program, which needs to identify and control new incursions rapidly to be effective.

We can no longer afford to consider biosecurity as the sole domain of peak bodies to stop new arrivals at the border. Instead it's time to think of biosecurity as an activity that's incorporated into your IPM. In fact, on-farm monitoring is a key component of biosecurity surveillance, while techniques from the IPM toolkit can reduce establishment of new arrivals.

But effective IPM doesn't stop at the farm gate. Increasingly the whole world is growing the same crops, using the same chemicals to try and control the pests that attack them, and inevitably spreading those pests throughout the world. Working together will be key to surveillance and effective pest management. Therefore, growers are encouraged to share their IPM practises, learnings and observations throughout growing regions, across different industries throughout Australia and even worldwide. While comprehensive monitoring and management on this scale may not instantly solve all pest problems, ultimately it will place growers everywhere in the best position to protect against resistance.

FIGURE 1: IPM uses monitoring of known pests to drive selection from a diverse kit of tools and depends on a strong social foundation. Biosecurity (prevention) should be incorporated into IPM, because IPM and biosecurity rely on similar social frameworks. On-farm monitoring for new arrivals is a key part of the industry's surveillance, and pest management will affect how likely it is for exotic incursions to establish.

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