

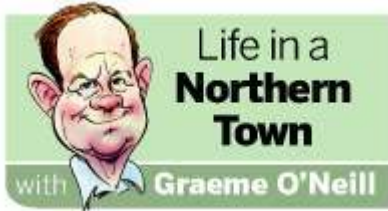


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GM wheat looms large

Industry will be ready for virulent new rust fungus when it arrives

By Graeme O'Neill



WE LIVE in a green horticultural island, amid a vast sea of wheat. Drive from Mildura to Bendigo, or from Mildura to Adelaide, and wheat fields stretch out to the horizon.

In a good year, Australia grows up to 25 million tonnes of wheat, ranking us around seventh behind nations like China, India, the US, Russia, France and Pakistan. We are the world's largest wheat exporter.

So consider the following plot for a science fiction/horror movie.

An African wheat breeder ignores a protocol requiring all new varieties to contain at least two different genes for resistance to stem rust fungus.

The new variety is duly released to Ugandan farmers. In the field, it's exposed to stem rust, which constantly probes its defences with new, mutant strains.

For a time, the wheat's single resistance gene holds firm, but inevitably, a mutant rust breaks through, devastating the new wheat variety. Billions of wind-borne spores settle on crops of other wheat varieties downwind.

These varieties should

be doubly protected, because their breeders installed two independently acting resistance genes for stem rust.

But they're vulnerable: the Ugandan breeder's blunder has rendered one resistance gene useless, dramatically improving the odds of the rust overcoming the backup gene.

Within a season, the Armageddon rust is rampant, and destroying 80 per cent of all wheat crops. From Uganda, it rides the wind to Asia Minor, laying waste to crops in Iran. The vast wheat lands of Pakistan, India and China now lie in its path.

In Africa, it spreads to Tanzania, Zimbabwe and South Africa. Freakish weather lofts its spores into the stratosphere, and they ride a 350km/h jet stream across the Indian Ocean.

Out of the blue, a virulent new rust fungus rages through Western Australia's wheat belt. It spreads east, and within months, is destroying wheat crops in the SA and Victorian Mallee and Millewa.

By now you will suspect this nightmarish scenario is something more than the lurid im-

aginings of a Hollywood script writer. You're right.

The Armageddon rust strain emerged in Uganda in 1999, just as described, and is already in Asia Minor. No resistance genes exist in the immediate gene pool of bread wheat or its cousin, durum wheat.

Inevitably, the jet-stream highways that girdle the globe will spread Ug99 around the world. New strains of stem and stripe rust originating in Africa have previously vaulted the Indian Ocean to infect crops in Australia.

A pandemic of Ug99 could cause famine on six continents.

Ug99 would be disastrous for Australia's economy. Fortunately Australian geneticists are already working to neutralise its threat.

With no resistance genes available in wheat or its near relatives, CSIRO wheat geneticist Dr Phil Larkin has found one in a more distant, grassy relative of bread wheat, *Thinopyrum ponticum*.

The techniques for transferring desirable genes into wheat from its grassy relatives have been around for half

a century, but they involve transferring whole chunks of chromosomes from grassy relatives, that carry not only the desired resistance gene, but hundreds of neighbouring genes that can introduce inferior or unwanted traits into bread wheat, like bright yellow flour.

Without going into complex detail, Dr Larkin has pioneered a way of clustering wild-sourced resistance genes in a genetic "cassette" and installing them in bread wheat by conventional breeding – without importing their disruptive neighbours.

His CSIRO Plant Industry team in Canberra has assembled a set of resistance genes from *Thinopyrum ponticum* and its cousin, *T. intermedium*, and installed them on wheat chromosome 7.

The "cassette" not only confer full protection against all races of Ug99 stem rust, it will arm new wheat varieties against stripe rust and leaf rust.

And, for good measure, it will also confer resistance to aphid-transmitted Barley Yellow Dwarf Virus (BYDV). In



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VIRULENT: New strains of stem and stripe rust originating in Africa have previously vaulted the Indian Ocean to infect crops in Australia.

a bad season, BYDV can cause yield losses of up to 30 per cent in some wheat crops, and no resistance genes are avail-

able in wheat

It's a massive achievement: an all-in-one solution to four of the wheat industry's worst

pathogens. The CSIRO researchers have gifted the protective gene cassette to Australian wheat breeders in special "Pontin" breeding lines.

As new diseases emerge, they can add more resistance genes to the cassette, using genetic modification (GM) techniques.

In 2004, anti-GM campaigners and "green" WA politicians drove Australia's only GM wheat breeding company, Perth-based Grainbiotech, out of business.

Grainbiotech was field-testing a salt-tolerant GM wheat that grows

in salinised soils and had developed a novelty GM wheat containing resveratrol, an anti-ageing, anti-cancer compound from red wine.

Victorian farmers now grow GM canola. Are we ready for "designer" GM wheat varieties, which promise huge economic benefits to the wheat industry and farmers, and health benefits to all?

With luck, Australia's wheat industry will be ready for Ug99 when it arrives – and any other Armageddon fungus nature can throw against it. GM wheat looms large in the wheat industry's future.

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